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FUEL-CELL SYSTEM

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[Abstract]

The invention relates to a fuel-cell system with at least one fuel cell and a compressor for supplying air to one or more fuel cells and sound-absorbing means for damping sound in the air path of the fuel-cell system, with the sound-absorbing means being formed as a broadband muffler.

[0001]

The invention relates to a fuel-cell system according to the preamble of the independent Claim 1.

[0002]

Noise emissions are observed in various system regions of fuel-cell systems, especially in pipes of fuel-cell systems that operate with air compressors, such as Roots blowers or Wankel compressors. Such emissions are especially undesired for the use of fuel-cell systems in vehicles or in plants, where noise emissions are disruptive.

[0003]

The use of mufflers to decrease noise emissions in vehicles is known. For example, suction mufflers or end mufflers are frequently used.

[0004]

The invention is based on the problem of providing a fuel-cell system with reduced noise emissions.

[0005]

This problem is solved by a fuel-cell system with the features of Claim 1.

[0006]

In a fuel-cell system according to the invention with at least one fuel cell, sound-absorbing means for damping sound are inserted in the air path. The sound-absorbing means are arranged essentially in regions of the air path, where noise emissions are generated. It is advantageous to provide sound-absorbing means at the inputs and outputs of the noise source.

[0007]

Here, the sound-absorbing means are preferably formed especially as broadband mufflers.

[0008]

The special advantage is that the sound is damped at the positions where it is generated. Therefore, smaller components can be used for sound absorption, so that voluminous end mufflers can be eliminated. This is especially advantageous for using the fuel-cell system

according to the invention in vehicles, where strict limitations exist relative to the available space. Furthermore, such a fuel-cell system or vehicle has significantly improved acoustic behavior. The use of broadband mufflers allows particular combinations of broad noise-emission frequency spectra to be damped favorably.

[0009]

Additional advantages and configurations of the invention follow from the other claims and from the description.

[0010]

In the following, the invention is explained in more detail with reference to a drawing. Shown are:

Figure 1, a section from a fuel-cell system according to the invention with a first favorable arrangement of mufflers,

Figure 2, a section from a fuel-cell system according to the invention with a second favorable arrangement of mufflers, and

Figure 3, an advantageous arrangement of sound-absorbing means.

[0011]

The invention is especially suitable for the use of fuel-cell systems in mobile systems, such as fuel-cell vehicles. However, the invention should not be restricted to this use.

[0012]

Figure 1 shows schematically a section of an advantageous configuration of the fuel-cell system according to the invention with reference to an air path of the system. In the flow direction S, a suction device 8 for suctioning air, an air filter 9, and a first muffler 10 are arranged along an air path 7. The air path 7 then branches into a first path section 7.1 and a second path section 7.2.

[0013]

In the first path section 7.1, a second muffler 11, a fuel-cell unit 12, and a third muffler 13 are arranged in the flow direction S. In the second path section 7.2, a fourth muffler 14 and a catalytic burner 15 are arranged in the flow direction S.

[0014]

Downstream of the catalytic burner 15 and the third muffler 13, the two path sections 7.1, 7.3 are re-joined into a common air path 7.3, in which a fifth muffler 16 is arranged in the flow direction S.

[0015]

The mufflers 10, 11, 13, 14, 16 are advantageously arranged at positions in the system where disruptive noise is generated, e.g., due to pulses of a fluid in fluid-carrying lines. Thus, noise emission is prevented exactly at the positions where noise is generated. The noise transfer along the lines, here, the air path 7, 7.1., 7.2, 7.3, is therefore significantly reduced. Thus, an end muffler at the end of the air path 7, 7.1, 7.2, 7.3 and/or a suction muffler at its beginning can be reduced in size somewhat or even completely eliminated.

[0016]

Especially for use in a fuel-cell vehicle, it is advantageous when voluminous components can be eliminated.

[0017]

The mufflers 10, 11, 13, 14, 16 can be configured such that they are suitable for damping a frequency range for sound absorption from at least 400 Hz to 4000 Hz. This corresponds to a setting to the frequency ranges, in which the compressor-expander unit and the fan of the catalytic burner 15 emit noise at undesired volumes. A preferred sound-absorber type is a so-called Helmholtz muffler. This consists of, e.g., two concentric cylinders with rows of essentially equidistant holes in the radial direction being formed in the inner cylinder and a plurality of such rows of holes following one another in the axial direction. The axial intervals of the rows of holes can vary. Thus, at one end of the cylinder there can be a high density of rows of holes and the density can decrease towards the other end of the cylinder. If the density is high, preferably high frequencies are damped. If the density is low, preferably low frequencies are damped. The volume between the cylinders can be divided into chambers in order to improve the damping.

[0018]

It is especially advantageous to arrange the mufflers 10, 11, 13, 14, 16 at least adjacent to regions of media-carrying lines subjected to pulses in the air. The first muffler 10 is arranged at the input to the compressor and to the fan of the catalytic burner. The second muffler 11 is arranged at the output of the compressor and at the input to the fuel-cell unit 12. The third

muffler 13 is arranged at the input to the expander of the compressor-expander unit. The fourth muffler 14 is provided at the input to the catalytic burner. The fifth muffler 16 is arranged at the output of the expander and at the output of the fan of the catalytic burner 15.

[0019]

It is favorable to arrange the sound-absorbing means 10, 11, 13, 14, 16 essentially rotationally symmetrically about the lines 7, 7.1, 7.2, 7.3 or around the inputs of the compressor and fan or the outputs of the compressor and fan. The sound-absorbing means are preferably manufactured from metal, especially preferred from aluminum or an aluminum alloy. This enables good sound absorption without increasing the weight of the system too much. It is especially favorable to use mufflers made from polyamide or stainless steel upstream of the fuel cells in order to prevent contamination of the fuel cells with aluminum.

[0020]

Figure 2 shows schematically another configuration of a fuel-cell system with preferred broadband mufflers. A suction device 2 for suctioning air, an air filter 3, a first muffler 4, a compressor-condenser unit 5 for supplying air to a cathode of a (not-shown) fuel-cell unit of the fuel-cell system, and a second muffler 6 are arranged in the flow direction along an air path 1. The fuel-cell unit features at least one fuel cell with an anode space and a cathode space, wherein the cathode space and the anode space are separated by an ion-introducing membrane.

[0021]

Air is suctioned through the suction device 2 and guided over the air filter 3 into the compressor of the compressor-condenser unit 5, compressed there, and supplied to the cathode of the fuel-cell unit 12. Due to the compression of the air in the air path 1, typical flow conditions generate pulses of the air, which produce considerable noise emissions. The first muffler 4 is arranged upstream of the compressor at its input side and the second muffler 6 is arranged downstream of the compressor to the compressor-condenser unit 5 at the output of the compressor.

[0022]

According to the invention, the first and second mufflers 4, 6 are formed as broadband mufflers. Typical mufflers, such as commercially available end mufflers or suction mufflers, which are formed as absorption-reflection mufflers, can damp only a small portion of the generated noise spectrum. In contrast, the broadband mufflers are formed such that they can damp essential frequencies of the noise spectrum. Preferably, the sound-absorbing means are

formed so that they exhibit a frequency range for sound absorption that corresponds essentially to the frequency range of the noise emissions of the associated sound-absorbing body.

[0023]

Figure 3 shows an advantageous arrangement of sound-absorbing means in a fuel-cell system. A noise source 17 is arranged in a media-carrying line 20. At the input and at the output of the noise source 17, there is a muffler 18, 19, respectively. It is especially favorable if the mufflers 18, 19 are integrated in the line 20 so that they can carry media directly. The mufflers 18, 19 enclose the line or the flow path 20 similar to a collar and are attached preferably as close as possible to the input and/or output of the noise source 17.

[0024]

For the use of sound-absorbing means, such as Helmholtz mufflers, whose damping capacities are frequency-dependent along their axis that can carry media, the installation direction is selected especially so that the region of the muffler 17, 18 facing the noise source 17 damps high frequencies better than low frequencies.

[0025]

The fuel-cell system according to the invention is advantageously used in a fuel-cell vehicle.

Claims

1. Fuel-cell system with at least one fuel cell (12) and a compressor for air supply to the one or more fuel cells (12) and sound-absorbing means (10, 11, 13, 14, 16, 18, 19) for absorbing sound in the air path (7, 7.1, 7.2, 7.3) of the fuel-cell system, for which the sound-absorbing means (10, 11, 13, 14, 16) are arranged essentially in regions of the air path (7, 7.1, 7.2, 7.3) where noise emissions are generated.

2. Fuel-cell system according to Claim 1, characterized in that the sound-absorbing means (10, 11, 13, 14, 16, 18, 19) are arranged at least adjacent to regions of media-carrying lines (7, 7.1, 7.2, 7.3) where pulses are generated in the guided media.

3. Fuel-cell system according to Claim 1, characterized in that the sound-absorbing means (10, 11, 13, 14, 16, 18, 19) enclose the media-carrying lines (7, 7.1, 7.2, 7.3) or are integrated in the line, so that they can carry media directly.

4. Fuel-cell system according to Claim 1, characterized in that the sound-absorbing means (10, 11, 13, 14, 16, 18, 19) are formed as broadband mufflers.

5. Fuel-cell system according to Claim 1, characterized in that the sound-absorbing means (10, 11, 13, 14, 16, 18, 19) exhibit a frequency range for sound absorption, which essentially corresponds to the frequency range of the noise emissions.

6. Fuel-cell system according to Claim 2, characterized in that the frequency range for sound absorption ranges at least from 400 Hz to 4000 Hz.

7. Fuel-cell system according to Claim 1, characterized in that the sound-absorbing means (10, 11, 13, 14, 16, 18, 19) are arranged at a noise source so that high frequencies can be damped close to the noise source and low frequencies can be damped far from noise source.

8. Fuel-cell system according to Claim 1, characterized in that the sound-absorbing means (10, 11, 13, 14, 16, 18, 19) are arranged at the input and output of the compressor.

9. Fuel-cell system according to Claim 1, characterized in that the sound-absorbing means (10, 11, 13, 14, 16, 18, 19) are arranged at the input and output of a fan for supplying air to a catalytic burner (15).

10. Fuel-cell system according to Claim 1, characterized in that a first broadband muffler (10) is arranged downstream starting from a supply of air (8, 9) in an air path (7) with a flow direction (S), the air path (7) downstream of the first broadband muffler (10) is divided into a first path section (7.1) and a second path section (7.2), a compressor is arranged downstream in the first path section (7.1), a second broadband muffler (11) is arranged downstream of the compressor and upstream of a cathode air supply (11.1) to the one or more fuel cells (12), a third broadband muffler (13) is arranged downstream of the one or more fuel cells (12) and upstream of an expander, such that downstream in the second path section (7.2) a fourth broadband muffler (14) is arranged upstream of a fan for supplying air to a catalytic burner (15), the catalytic burner (15) is arranged downstream of the fan, the first and second path sections (7.1, 7.2) are combined again into a common air path (7.3) downstream of the catalytic burner (15) and downstream of the expander, and a fifth broadband muffler (16) for damping an output side (16.1) from the expander and fan is arranged in the common air path (7.3).

11. Fuel-cell system according to Claim 1, characterized in that the sound-absorbing means (10, 11, 13, 14, 16, 18, 19) are formed from aluminum or an aluminum alloy or stainless steel or plastic.

12. Use of the fuel-cell system according to Claim 1 in a fuel-cell vehicle.

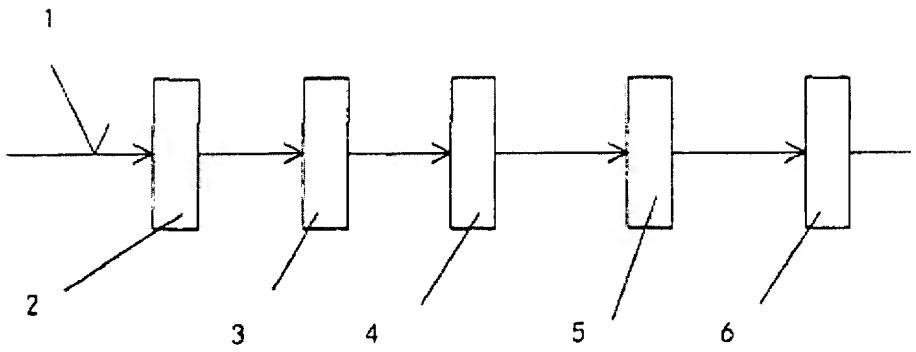

Fig. 1

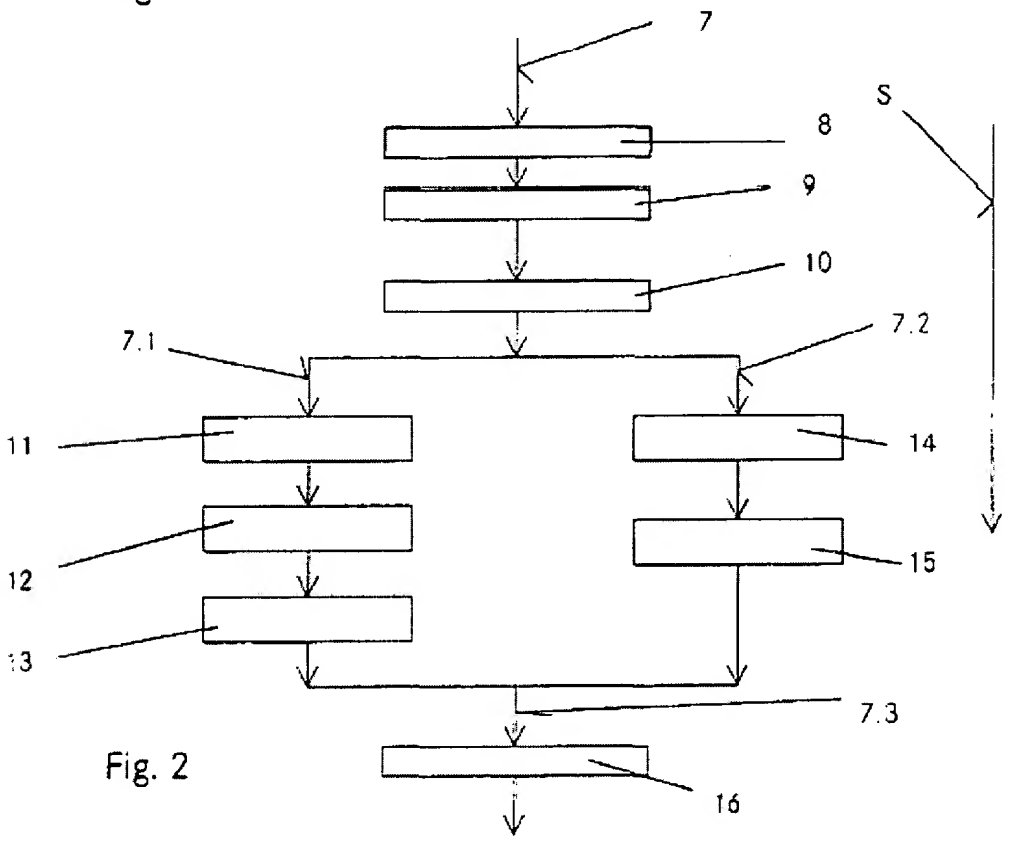

Fig. 2

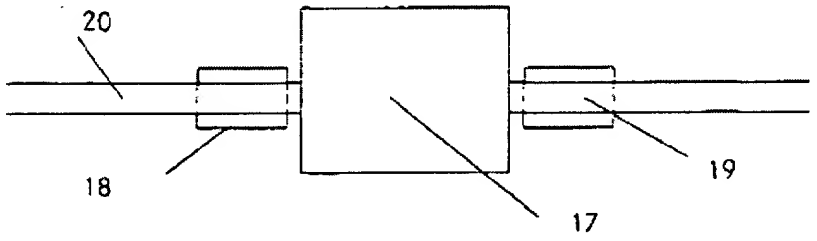

Fig. 3